COURSE: FUNCTIONAL DESIGN

SUBJECT: Functional Design
MODULE: Process and Product Engineering
STUDIES: MASTER IN CHEMICAL ENGINEERING

GENERALES FEATURES

Type: ☐ Basic training, ☑ Mandatory, ☐ Elective

☐ Master thesis, ☐ Internship

Duration: Semestral **Semester/s**: 1
Number of ECTS: 3
Language/s: English, may include sessions in Spanish.

DESCRIPTION

BRIEF DESCRIPTION AND JUSTIFICATION

The design is at the heart of all engineering disciplines. For Chemical Engineering, functional design involves setting the size and basic measures of the items that constitute a process. Although the proper field of chemical engineering is mass transport, this course includes a brief introduction to heat transfer operations.

The course is essentially an extension of the application of transport mechanisms (mass, heat and momentum) for dimensioning industrial equipment. Examples can be gas absorption, water cooling, adsorption, membrane separations and distillation. Finally, the basic methods for designing heat exchangers are presented.

SKILLS

- CB6 – The student has knowledge and understanding of what constitutes a basis or an opportunity to be original by developing and/or applying ideas, often in a research context.
- CB7 – The student can apply their knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to his/her field of study.
- CG1 - The student can design, manage, execute and expose a project.
- CE1 – The student is able to apply knowledge of mathematics, physics, chemistry, biology and other natural sciences – obtained through study, experience and practice – with critical reasoning to establish economically viable solutions to technical problems.
- CE2 – The student can design products, processes, systems and services for the chemical industry as well as optimize other already developed, on the technological basis the various areas of Chemical Engineering, involving processes and transport phenomena, separation operations and reactor engineering, both chemical and nuclear, electrochemical or biochemical.
- CE3 – The student can conceptualize engineering models, apply innovative methods in problem solving and use suitable software for the design, simulation, optimization and process and system control.

PREREQUISITES

Admission to the Master in Chemical Engineering of the Universitat Ramon Llull.

CONTENTS

1. Mass transport.
   1.1. Laws of diffusion.
   1.2. Models to describe mass transfer at the boundary of a phase.
2. Design of differential continuous contact equipment.
   2.1. Gas absorption, including simultaneous mass and heat transfer.
   2.2. Humidification and water cooling.
3. Design based on ideal plates.
   3.1. Multicomponent distillation.
   3.2. Separation especifications.
   3.3. Short-cut and rigorous methods.
4. Gas-liquid contact.
   4.1. Packed towers: types of packing, internals and calculations.
   4.2. Tray columns: types of plates and calculations.
   4.3. Special equipment: structured packing, static mixers.
5. Heat transfer equipment.
   5.1. Heat exchangers.
   5.2. Heat exchangers design.

METHODOLOGY

TRAINING ACTIVITIES

Training activities	ECTS	Skills
Concept sessions.	0,72	CB6
Sessions solving exercises, problems and cases.	0,28	CB7 CE1, CE2, CE3
Seminars.	0,30	CB3, CE6
Practical work / projects / laboratory.	0,50	CG1 CE1, CE2, CE3
Personal study activities of students.	1,00	CB6, CB7 CE1, CE2, CE3
Evaluation activities.	0,20	CB6, CB7
TOTAL	**3,00**	

EXPLANATION OF THE TEACHING METHODOLOGY

This course uses the following teaching methodologies:

- Concept sessions by presentation or explanation (possibly including demonstration) by the professor and/or students.
- Solving exercises / problem solving and presentation / discussion of cases by the professor with the active participation of students.
- Instruction driven by the professor to review, discuss and resolve questions about the materials and topics presented in concept sessions, in solving sessions exercises, problems and cases. It could include visits to companies and facilities.
- Oral presentations by students.
- Personal work of the student to acquire and share the skills of each subject.
- Oral and written tests to assess skills acquired.

The course is developed primarily in English.

EVALUATION

ASSESSMENT METHODS

Methods of evaluation	Weight	Skills
Exams.	35 – 45%	CB6, CB7 CE1, CE2, CE3
Monitoring activities.	30 – 40%	CB6, CB7, CG1 CE1, CE2, CE3
Homework and presentations.	10 – 20%	CB6, CB7, CG1
Participation	10%	CB6, CE2, CE3

LEARNING OUTCOMES

Students will develop:

- Knowledge allowing to perform original developments.
- Ability to apply their knowledge to establish economically viable solutions.
- Skills in problem solving in new environments.
- Ability to plan and design a project.
- Ability to apply their knowledge with critical thinking to establish economically viable solutions to technical problems.
- Ability to design processes, systems and services for the chemical and related industries.
- Ability to formulate engineering models, apply innovative methods in problem solving and use appropriate software for the design of processes and systems.

EVALUATION

The final exam has a value of 35% of the final grade.

- A minimum grade of 4/10 in the final exam is required to pass the course. If a grade lower of 4/10 were obtained, it will be the final grade of the course.

Monitoring activities consist of quizzes (individual), individual and group works and laboratory. Its weight in the final score is 45%: 5% quizzes, 30% works & theory preparation and 10% laboratory.

- A minimum grade of 5/10 of the laboratory is required to pass the course. If a grade lower of 5/10 were obtained, it will be the final grade of the course.

Presentations will have a weight of 10% of the final grade. They reflect the performance in developing small projects and communicate them in joint seminars.

The weight of participation is 10% of the final score. It will be evaluated according to the active participation in discussions (class) and forums (virtual campus).

EVALUATION OF SKILLS

- CB6: 35% final exam + 45% monitoring activities + 20% homework and present.
- CB7: 35% final exam + 45% monitoring activities + 20% homework and present.
- CG1: 50% monitoring activities + 50% homework and presentations.
- CE1: 50% final exam + 50% monitoring activities.
- CE2: Final score.
- CE3: Final score.

BIBLIOGRAPHY

Textbook:

- Sinnott, Ray K. and Towler, Gavin. Chemical Engineering Design (SI Edition). 5th Edition 2009 (reprint 2012). Elsevier: Butterworth-Heinemann.

Other:

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- R. E. Treybal; "Mass Transfer Operations"; 3rd ed., McGraw-Hill International Editions, Singapore 1981.
- Nueva edición: 1998, (ISBN 0070666156 - agotado)
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- Kirk-Othmer; “Encyclopedia of Chemical Technology”; Wiley Inrscience, New York 1978 (3ª edición).
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- J. J. McKetta; ”Encyclopedia of Chemical Processing and Design”; Marcel Dekker Inc., New York.
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DOCUMENT RECORD

PREVIOUS CHANGES
J. Sempere. 11/04/2013; 15/09/2015; 15/08/2017

LAST REVISION
J. Sempere. 01/10/2010